Insurance status does not affect short-term outcomes after oncological colorectal surgery in Europe, but influences the use of minimally invasive techniques: a propensity score-matched analysis

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Abstract: Background and Purpose Controversy exists whether surgical treatment is influenced by insurance status. American studies suggest higher morbidity and decreased survival in uninsured patients with colorectal cancer (CRC). It remains elusive, however, whether these findings apply to European countries with mandatory, government-driven insurance systems. We aimed to analyze whether operative techniques, quality of surgery, and complication rates differ among patients covered by statutory (SI) versus private (PI) healthcare insurance. Methods Based on a prospective national surgical quality database, patients undergoing elective resection for CRC during 2007–2015 were identified. A propensity score match of eligible patients with SI and PI yielded 765 patients per group. Results Hierarchical status of the operating surgeon differed substantially ($p = 0.001$): junior surgeons operated on $> 50\%$ of patients with SI, whereas over 80% of patients with PI were operated by senior surgeons. Minimally invasive techniques were used more frequently in patients with PI ($p = 0.001$) and patients with SI undergoing colonic resection showed an increased conversion rate (OR 2.44). Median duration of surgery ($p = 0.001$) and blood loss ($p = 0.002$) were higher in patients with SI; however, length of hospital stay was equal. Neither the rate of positive resection margins nor the number of resected lymph nodes differed among groups. Complications and mortality occurred with similar frequencies for patients undergoing colon ($p = 0.140$) and rectal ($p = 0.335$) resection.

DOI: https://doi.org/10.1007/s00423-018-1716-8

SUBMISSION TO THE "LANGENBECK'S ARCHIVES OF SURGERY"

ORIGINAL ARTICLE

INSURANCE STATUS DOES NOT AFFECT SHORT-TERM OUTCOMES AFTER ONCOLOGICAL COLORECTAL SURGERY IN EUROPE, BUT INFLUENCES THE USE OF MINIMALLY INVASIVE TECHNIQUES

A PROPENSITY SCORE MATCHED ANALYSIS

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Short Title for Running Head:

Insurance Status does not affect Surgical Outcomes
(44 Letters)

Conflicts of interest:

The authors declare no conflict of interest. No third-party financial funds or materials were accepted or necessary for execution of this research project.

Keywords:

Insurance Status

Colorectal Surgery

Colorectal Carcinoma

Outcome

Complications

Word Count:

Short Title	44
Abstract:	248
Main Text/Manuscript:	2674
Figures:	2
Tables:	3
Supplementary Information:	10

ABBREVIATIONS

CRC	Colorectal carcinoma
SI	Statutory insurance
PI	Private insurance
Supp. Info.	Supplementary information
Fig.	Figure
Tab.	Table
MIS	Minimally invasive surgery
IQR	Interquartile range
NA	Not available

CONTRIBUTIONS OF AUTHORS

	Study conception and design	Acquisition of data	Analysis & interpretation of data	Drafting of manuscript	Critical revision of manuscript
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ABSTRACT

Background & Purpose:

Controversy exists whether surgical treatment is influenced by insurance status. American studies suggest higher morbidity and decreased survival in uninsured patients with colorectal cancer (CRC). It remains elusive, however, whether these findings apply to European countries with mandatory, government-driven insurance systems. We aimed to analyze whether operative techniques, quality of surgery and complication rates differ among patients covered by statutory (SI) versus private (PI) healthcare insurance.

Methods:

Based on a prospective national surgical quality database, patients undergoing elective resection for CRC during 2007-2015 were identified. A propensity score match of eligible patients with SI and PI yielded 765 patients per group.

Results:

Hierarchical status of the operating surgeon differed substantially (p=0.001): Junior surgeons operated on >50% of patients with SI, whereas over 80% of patients with PI were operated by senior surgeons. Minimally-invasive techniques were used more frequently in patients with PI (p=0.001) and patients with SI undergoing colonic resection showed an increased conversion rate (OR 2.44). Median duration of surgery (p=0.001) and blood loss (p=0.002) were higher in patients with SI; however, length of hospital stay was equal. Neither the rate of positive resection margins nor the number of resected lymph nodes differed among groups. Complications & mortality occurred with similar frequencies for patients undergoing colon (p=0.140) and rectal (p=0.335) resection.

Conclusion:

The use of minimally invasive techniques was favored in patients with PI, however the quality of oncological resection was not affected by insurance status and only minor differences in perioperative complications observed.

INTRODUCTION

Colorectal Cancer (CRC) remains the third most common reason of cancer-related deaths worldwide and the second most common in first-world countries[1]. Surgery constitutes the main treatment modality for CRC, if a curative treatment approach is chosen[2,3].
Various factors are known to influence perioperative outcomes and complications after oncological colorectal surgery, including extent of comorbidities, the caseload of the treating hospital as well as the experience of the individual surgeon[4]. What remains less well examined, however, is how outcomes depend on the level of healthcare insurance.
Several studies analyzing the situation in the United States, where basic healthcare insurance is not mandatory, show different outcomes depending on insurance levels. A landmark study comprising 64,304 American CRC patients demonstrated lower overall oncological survival in patients without private insurance (PI) and an increased level of comorbidities at time of first diagnosis[5]. Uninsured patients also present with cancerous lesions more often in a late and metastasized state[6]. Importantly, survival in these studies remained worse also after adjusting for comorbidities and covariates.
Consistent with the above reports, patients undergoing surgery for CRC without insurance or Medicaid-coverage only showed an increased rate of emergent admissions with more frequent perioperative complications, increased rates of in-hospital deaths and higher postoperative morbidity[7].
These findings seem to hold true for oncological diseases in general. It was observed that uninsured patients present more frequently with advanced disease stages, especially in cancers which are potentially recognizable through screening[8]. A recent study confirmed that uninsured patients generally present with more complex disease stages in the emergency department[9] and consequently more commonly need an emergency operation[10]. Furthermore, insurance status has also been shown to influence long-term outcomes after elective oncological surgery. A large cohort from the Nationwide Inpatient Sample database comprising patients with lung resection, esophagectomy, pancreatectomy and gastrectomy consistently reported increased mortality rates for un- or Medicaid-insured patients[11].

As most reports on the influence of insurance status are performed in the US healthcare system, it raises the question whether similar shortcomings exist in other parts of the world.
Many countries, including European ones, have mandatory statutory healthcare insurance (SI), covering all medical necessary care. Patients may opt for additional PI, which provides certain benefits with respect to accommodations and amenities, treatment at private hospitals and the choice of the operating surgeon. Older reports show increased rates of non-oncological operations in patients with PI like appendectomies or cholecystectomies with a concomitant higher percentage of negative pathological specimens after appendectomies[12,13]. The influence of insurance status on outcomes for oncological surgery in Europe, however, remains elusive.

We therefore intended to examine whether patients with basic SI show impaired outcome after oncological surgery. Our hypothesis is that patients with SI receive an oncological operation of inferior technical quality compared to patients with PI, show differences in their perioperative course and suffer from higher perioperative morbidity. To test this hypothesis, we have queried our nation's largest surgery quality database.

METHODS

Database processing

An extraction of the prospective, largest nationwide surgical quality control AQC database (*Arbeitsgemeinschaft für Qualitätssicherung in der Chirurgie, Switzerland*)[14,15] was performed on the 16th of May 2016, compromising data of 42'689 patients undergoing various surgical procedures performed between the 1st of January 2007 and 31st of December 2015.
The database was filtered for patients with the main diagnoses colorectal cancer according to the current ICD-10-GM definitions (Version 2016), yielding 5343 patients in which a malignant neoplasm of the colorectal tract was the reason for hospitalization. In a second step, patients undergoing a colonic or rectal resection for their malignant disease were selected based on the applied surgical codes[16] for partial/segmental colectomy (including hemicolectomy left/right), total colectomy and rectal resection, resulting in 3624 eligible patients. Refer to supplementary information (Supp. Info. 1-3) for information how to assess the AQC database and the codes used for filtering.

To acquire the most representative sample of patients undergoing elective colorectal surgery for CRC, remaining patients were then sequentially filtered for procedures labelled explicitly as planned & elective (in contrast to emergent procedure or unplanned), thereby excluding 1363 patients. Successively, patients were filtered and removed if a complication of a previous surgical intervention was indicated as reason for surgery (n=18), indication of age was missing, or age was below 18 years (n=1), duration of surgery was missing or indicated as <60minutes (n=36), indication of insurance class was not given (n=26), or ASA Score was missing (n=18). Duplicate entries were identified based on the data for age, date of surgery, ASA-Score, date of admission, date of discharge, length of surgery and insurance-class (n=28) and consequently removed.

Propensity score matching

The final number of 2134 patients, consisting of 1369 patients with SI and 765 patients with PI was then used to perform a 1:1 propensity score match for patiens with SI versus patients with PI based on age, ASA-score, gender and the location of the primary tumor (colon, sigmoid or rectum). This matched 765 patients with SI with the 765 patients with additional PI and represented the final database used for the analyses (Fig. 1, Supp. Info. 5)

Endpoints

Due to considerable differences in the surgical procedure, patients undergoing colonic resection and patients undergoing rectal resection were separately analyzed. Patients with PI and SI in both groups were analyzed for differences in the level of experience of the operating surgeon, use of minimally-invasive surgical (MIS) techniques, rate of conversions from MIS to an open surgical approach, frequencies of stoma formation, blood loss, duration of surgery and length of hospital stay. Rate of incomplete (R1/R2) resections as well as number of resected & invaded lymph nodes served as surrogate parameter of the quality of oncological resection. Morbidity and mortality were examined via frequencies & severity of recorded complications.

Statistical analyses

Continuous data are given as median +/- interquartile range (IQR). Wilcoxon's rank sum test or Fisher's exact test were used to compare medians, resp. odds in the baseline groups. Statistical significance was defined as $p < 0.05$. No adjustment for multiple testing was performed when assessing rates of complications. All database processing, statistical analyses, propensity score matching, and graphical representations were done using R (Version 3.4.3) / R-Studio (Version 0.99.903) (Session Information: Supp. Info. 10).

RESULTS

Patient characteristics

After Propensity score matching, pre-existing differences in the distribution of gender, ASA-score, location of primary tumor and histological grade, were equalized, resulting in an even distribution of gender, comparable median age and ASA score levels between groups. The frequency of CRCs located in the colon, the sigmoid or the rectum did not differ among groups. Furthermore, no more difference was detected for levels of T-stage, N-stage, M-stage, L-stage, V-stage or histological grading, indicating an equal distribution of tumor stages in our patient cohort (Tab. 1).

Surgical & hospitalization parameters

With respect to the level of seniority of the operating surgeon, a clear difference was observed between patients with SI and patients with PI undergoing colon ($p \leq 0.001$) as well as rectal resection ($p \leq 0.001$). Junior or senior attending surgeons operated on >50% of patients with SI, whereas over 80% of patients with PI were operated by either a chief surgeon or a non-house surgeon in private practice. Residents were listed as operating surgeon in 11.5% of patients with SI undergoing colonic resection, while rates of residents were negligible in SI patients undergoing rectal resection or operations of both kinds in PI patients (Fig. 2A, Supp. Info 6: information on hierarchical positions of surgeons).

Regarding surgical technique, we found that traditional open operations were performed more frequently in patients with SI undergoing colon (OR: 1.79 [1.33-2.41], $p \leq 0.001$) as well as rectal resection (OR: 1.43 [1.04-1.97], $p \leq 0.001$), whereas robotic and laparoscopic surgery was used more frequently in patients with PI (Fig. 2B). While an elevated conversion rate of 30.7% among patients with SI versus 15.3% in patients with PI undergoing colon resection was observed (OR: 2.44 [1.34 – 4.51], $p = 0.002$), no major difference was detected in patients undergoing rectal resection (Tab. 2). Diverting loop Ileostomies or colostomies was performed with equal frequencies regardless of insurance status for both operations (Tab. 2, Supp. Info 4).

A difference was noted regarding the duration of surgery, with an average of 28 and 20 minutes longer median operative time for patients with SI undergoing colon and rectum resection respectively (Fig. 2C). Similarly, patients with SI had a higher median amount of surgeon-recorded blood loss for both types of resection (Fig. 2D). No difference in the length of hospital stay was observed for both colon and rectal resections (Fig. 2E).

Parameters of oncological resection

Positive resection margins were found in 3.8% in SI and 4.3% in PI patients undergoing colon resection and 3.9% and 4.3% of rectal resections respectively (Tab. 2). Similarly, no difference was detected when R1 and R2 resections were analyzed separately. Furthermore, neither the number of resected lymph nodes nor the number of lymph nodes testing positive for adenocarcinoma during histological analyses showed major difference among groups (Tab. 2).

Complication Rates

The grades of severity of intraoperative complications did not differ between patients with SI and PI for neither colon nor rectal resections (Tab. 3, Supp. Info. 7). No difference in the low recorded rates of individual intraoperative complication rates observed (Supp. Info. 8).
Similarly, the overall occurrence of postoperative complications was similar for both operations among patients with SI and PI (Tab. 3). Furthermore, the severity of postoperative complications as assessed using the Clavien-Dindo score[17,18] did not differ significantly for colon resections (p = 0.140, Tab. 3) and was also equal for patients undergoing rectal resection (p = 0.335, Tab. 3). A fatal complication was recorded in 3 patients with SI and 2 with PI. Considering specific postoperative complications, higher rates of pneumonia as well as wound healing disorders were recorded in patients with SI undergoing a colon resection compared to their matched PI counterparts (Tab. 3), while all other complications recorded, including surgery-related (anastomotic failure, wound infection/abscess, fascia dehiscence, seroma/hematoma, Tab. 3), cardiovascular, pulmonary, gastrointestinal, urogenital and infectious/others, showed comparable rates among the SI and PI patients for both operations (Supp. Info. 9).

DISCUSSION

Inequalities in the quality of health care among patients with different racial, social or economic backgrounds should be absent in an ideal healthcare system. However, several studies analyzing the influence of insurance status on surgical outcomes in the United States have shown worse short-term and long-term outcomes for uninsured or Medicaid-insured patients with CRC[7,19,20]. A recent study in JAMA oncology confirmed these observations, showing that recent improvements in survival were almost exclusively limited to patients with private or Medicare Insurance, while survival of uninsured or Medicaid insured patients stagnated or even declined[21]. Those findings are concerning, given that approximatively 15% of adults in the US are uninsured, with clear differences according to racial background and level of education, leaving minorities and less-educated people with a higher risk of surgical complications and cancer-related death[20]. However, it remains elusive whether similar observations may be made in European countries with mandatory government health insurance.

The present study was meant to test whether parameters of surgery, hospitalization and treatment related morbidity differ between patients covered by statutory basic insurance versus patients with additional private insurance in a European healthcare system. We applied a rigorous filtering algorithm to a large surgery quality control database and performed a consequent propensity score matching to acquire a meaningful and homogenous cohort of patients with basic SI and additional PI undergoing surgical resection of colon or rectal cancer.

In a first step, the level of the operating surgeon was analyzed. As a hallmark of private insurance is that patients can choose the operating surgeon, it is not surprising that a clear shift towards surgeons with higher levels of experience was observed. The majority of PI patients was operated by surgeons in private practice, which reflects the fact that patients with private insurance can resort to private hospitals with a higher level of amenities, which are not accessible to patients with basic statutory insurance only.
We furthermore observed that patients with PI were operated more frequently using minimally invasive techniques. This is in accordance with reports from the US healthcare system, which observed that uninsured patients are more likely to be operated with conventional open surgical techniques in contrast to patients with PI, which are operated more frequently using laparoscopy[22]. This might reflect the increased level of expertise of the operating surgeons, while additionally operations on private patients are normally not taught to junior staff or residents. Lastly, patients with private insurance have the possibility to choose the hospital of their choice, including private hospitals, which might have better infrastructure, e.g. more advanced equipment or systems for robotic surgery. Patients with statutory insurance are normally limited to receive treatment in the public hospital they were referred to.

The higher level of experience of operating surgeons is probably also reflected in shorter operation times as well as the lower reported blood loss of privately insured patients. Interestingly, despite higher blood loss, less experienced surgeons, longer operating times and more frequent open surgical approaches, no increase in the average length of hospital stay was observed in patients with SI. Additionally, the oncological quality of resection was not affected in our patient sample, as judged by the rate of R1 and R2 resections and the amount of retrieved and invaded lymph nodes. While shorter operation times and laparoscopic approaches might reduce the occurrence of certain perioperative complications and provide added patient comfort, the main goal of achieving radical oncologic resections was achieved to the same degree regardless of insurance status.

Interestingly, no difference was observed in either the overall complication rate, grades of severity of intra- and postoperative complications nor in the majority of rates of individual complications recorded in the database, including rates of surgery-specific complications like anastomotic leakage. Only the rate of pneumonias and wound healing disorders were higher in patients with SI. This might reflect the increased rate of open surgical approaches with impaired postoperative pulmonary function or might be a sequalae of longer operation times. While patients with SI were operated more frequently by surgeons of lower hierarchical status, no correlation between the rates and severity of complications and the level of expertise of the operating surgeon was observed. This pleasant finding underlines the high quality of peri- and postoperative care for patients independent of insurance state and surgeons' training.

While our study allows to draw conclusions on eventual differences in short-term outcomes between patients with SI and PI, it also has several limitations: First, entry of data into the database is voluntary and therefore prone to bias due to the selection of hospitals which enter their data. A second potential bias could occur if patients with bad perioperative outcome are not entered in the database despite total anonymity. This would explain the overall low rates of complications recorded in the database. This could further be complicated if data entry is performed through time-limited hospital staff, i.e. residents and junior surgeons, which are inadequately trained for this purpose. The applied propensity-score matching algorithm can account for observed differences; however potential biases through unknown underlying factors might still be present while the omittance of patients might lead to a loss of power. Lastly, as the AQC database only collects and provides perioperative data of the hospitalization, no conclusion about long-term complications and oncological outcomes (i.e. Cancer-specific survival or disease-free survival) can be drawn. Confirmation regarding similar oncological long-term outcomes among patients with SI and PI is therefore necessary.

In summary, our data of a large population-based cohort of CRC patients receiving surgical resection in a European healthcare system show that the use of minimally invasive techniques was favored in patients with PI. Similarly, differences in blood loss and length of surgery likely reflect the higher levels of training in surgeons operating on patients with PI coverage. However, the quality of the oncological resection was not affected and only minor differences in postoperative complication rates observed.

CONCLUSION

Insurance status does not affect perioperative outcomes in European patients with CRC in a significant manner and short-term oncological outcomes can be considered equal.

APPENDIX

Acknowledgement

The authors thank Luzi Rageth and the whole team of the AQC database for providing support during analysis of the extracted data.

Disclosure and conflict of interest

All authors declare no conflict of interest. No third-party financial funds or materials were accepted or necessary for execution of this research project.

FIGURE & TABLE LEGENDS

FIGURE 1: Flow diagram of database filtering & propensity score matching

FIGURE 2: Surgical parameters of patients with private insurance (PI) and statutory insurance (SI).

(A) A clear difference in the level of expertise of the operating surgeon was observed between patients with PI and SI ($p \leq 0.001$) for both resection types. (B) Patients with PI were operated more frequently using minimally invasive techniques. Patients with SI undergoing a colon resection also suffered of a twice as high conversion rate as patients with PI (OR 2.44, $p= 0.002$). (C) Patients with SI had increased median operation times (C) as well as increased recorded blood loss (D) compared to patients with PI. (E) However, despite increased blood loss, longer operating times and more frequent open surgeries, the overall length of hospital stay was equal among for both colon and rectal resections.

TABLE 1: Patient & tumor characteristics

TABLE 2: Parameters of surgery

TABLE 3: Complications

SUPPLEMENTARY INFORMATION

POINT 1: Information AQC database

POINT 2: ICD-10 codes for database filtering

POINT 3: Surgical CHOP codes for database filtering

POINT 4: Surgical CHOP codes for assessment of stoma formation

POINT 5/Figure: Distribution of propensity scores

POINT 6: Hierarchical positions in swiss surgical departments and corresponding English expressions used in the manuscript

POINT 7 Classification of severity of intraoperative complications

POINT 8/Table: Rate of specific intraoperative organ injures

POINT 9/Table: Rate of specific postoperative complications

POINT 10: Session Info R-Studio

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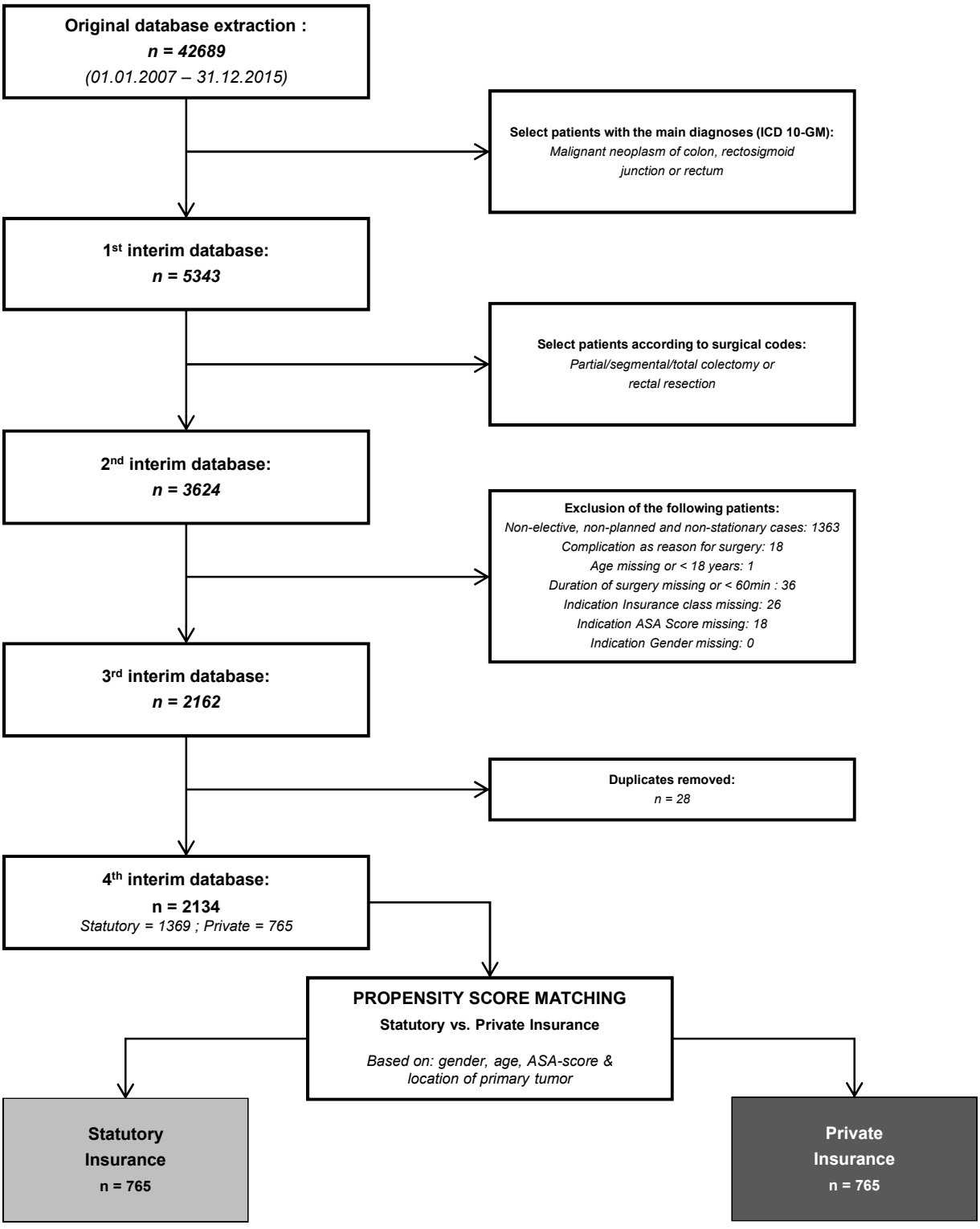
Original database extraction :
n = 42689
(01.01.2007 – 31.12.2015)
Select patients with the main diagnoses (ICD 10-GM):
Malignant neoplasm of colon, rectosigmoid junction or rectum
1st interim database:
n = 5343
Select patients according to surgical codes:
Partial/segmental/total colectomy or rectal resection
2nd interim database:
n = 3624
Exclusion of the following patients:
Non-elective, non-planned and non-stationary cases: 1363
Complication as reason for surgery: 18
Age missing or < 18 years: 1
Duration of surgery missing or < 60min : 36
Indication Insurance class missing: 26
Indication ASA Score missing: 18
Indication Gender missing: 0
3rd interim database:
n = 2162
Duplicates removed:
n = 28
4th interim database:
n = 2134
Statutory = 1369 ; Private = 765
PROPENSITY SCORE MATCHING
Statutory vs. Private Insurance
Based on: gender, age, ASA-score & location of primary tumor
Statutory Insurance
n = 765
Private Insurance
n = 765

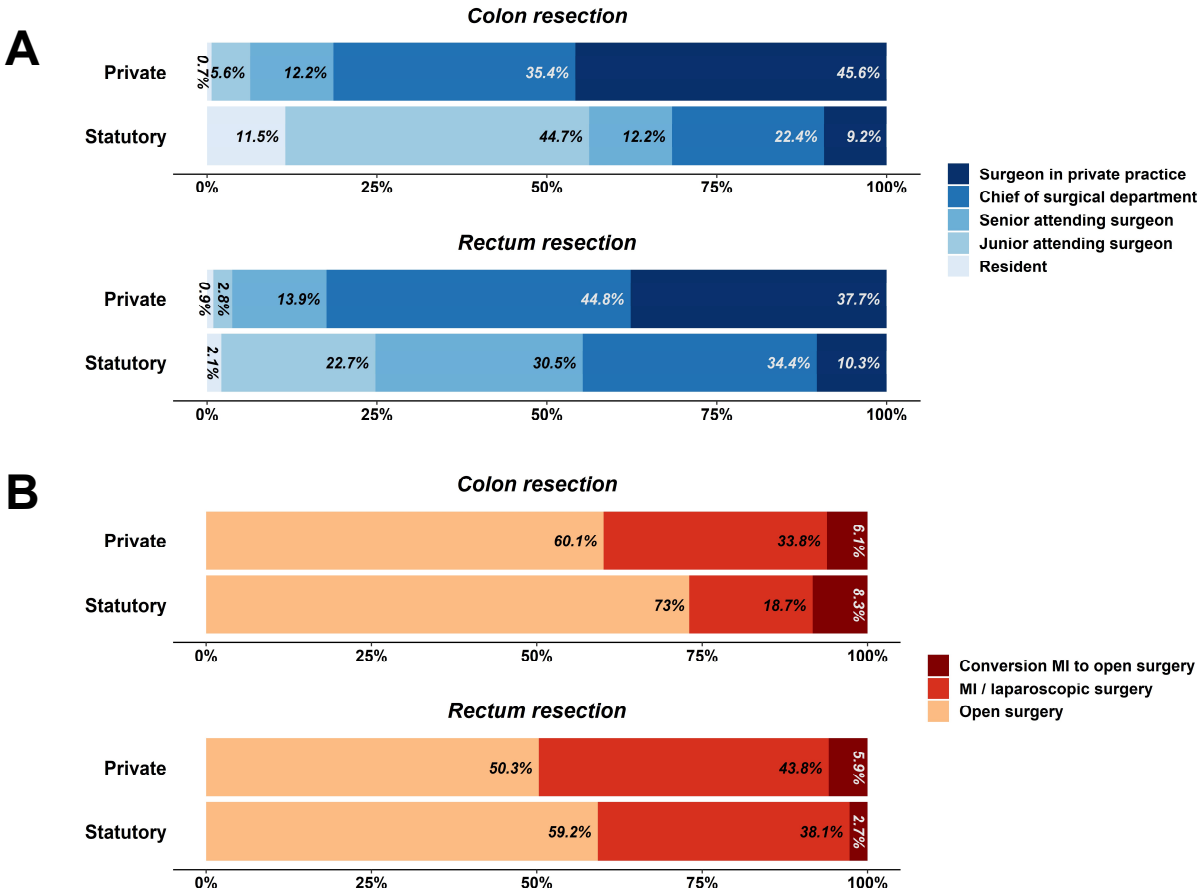
A
Colon resection
Private
Statutory
0.7%
5.6%
12.2%
35.4%
45.6%
11.5%
44.7%
12.2%
22.4%
9.2%
0%
25%
50%
75%
100%
Rectum resection
Private
Statutory
0.9%
2.8%
13.9%
44.8%
37.7%
2.1%
22.7%
30.5%
34.4%
10.3%
Surgeon in private practice
Chief of surgical department
Senior attending surgeon
Junior attending surgeon
Resident
B
Colon resection
Private
Statutory
60.1%
33.8%
6.1%
73%
18.7%
8.3%
Rectum resection
Private
Statutory
50.3%
43.8%
5.9%
59.2%
38.1%
2.7%
Conversion MI to open surgery
MI / laparoscopic surgery
Open surgery
C
Colon resection
Statutory
178 min [134 - 224.75]
Private
150 min [120 - 190]
p = 0.001
Insurance Status
Statutory
Private
0
100
200
300
400
Minutes
Rectum resection
Statutory
240 min [190 - 300]
Private
220 min [175 - 282.25]
p = 0.001
Insurance Status
Statutory
Private
0
100
200
300
400
500
Minutes
D
Colon resection
Statutory
150 ml [20 - 300]
Private
100 ml [30 - 200]
p = 0.002
Insurance status
Statutory
Private
2
4
6
log10 of blood loss in milliliters
Rectum resection
Statutory
200 ml [21.25 - 300]
Private
50.5 ml [0 - 200]
p = 0.002
Insurance status
Statutory
Private
4
6
8
log10 of blood loss in milliliters
E
Colon resection
Statutory
11 days [9 - 14]
Private
11 days [9 - 14]
p = 0.797
Insurance status
Statutory
Private
0
10
20
30
40
Days
Rectum resection
Statutory
13 days [10 - 17]
Private
13.5 days [11 - 17]
p = 0.245
Insurance status
Statutory
Private
0
10
20
30
40
Days

Table 1: Patient & tumor characteristics				
	Before matching (n=2134)		**After propensity score matching (n=1530)**	
	Statutory Insurance (n=1369) n= (%)	**Private Insurance (n=765)** n= (%)	**Statutory Insurance (n=765)** n= (%)	**Private Insurance (n=765)** n= (%)
Gender				
Male	809 (59.1%)	410 (53.6%)	408 (53.3%)	410 (53.6%)
Female	560 (40.9%)	355 (46.4%)	357 (46.7%)	355 (46.4%)
	$p = 0.015$		$p = 0.959$	
Age				
Median [IQR]	70 [61-78]	70 [62-77]	71 [62-78]	70 [62-77]
	$p = 0.232$		$p = 0.498$	
ASA-score				
Score I	128 (9.3%)	95 (12.4%)	87 (11.4%)	95 (12.4%)
Score II	680 (49.7%)	429 (56.1%)	428 (56.1%)	429 (56.1%)
Score III	526 (38.4%)	234 (30.6%)	243 (31.8%)	234 (30.6%)
Score IV	35 (2.6%)	7 (0.9%)	7 (0.9%)	7 (0.9%)
	$p \leq 0.001$		$p = 0.908$	
Location of tumor				
Colon	578 (42.2%)	398 (52.1%)	400 (52.3%)	398 (52.1%)
Sigmoid	132 (9.6%)	43 (5.6%)	34 (4.4%)	43 (5.6%)
Rectum	659 (48.1%)	324 (42.3%)	331 (43.3%)	324 (42.3%)
	$p \leq 0.001$		$p = 0.574$	
T-stage				
T1	243 (17.8%)	134 (17.5%)	129 (16.6%)	134 (17.5%)
T2	270 (19.7%)	148 (19.4%)	155 (20.3%)	148 (19.4%)
T3	679 (49.6%)	371 (48.5%)	393 (51.5%)	371 (48.5%)
T4	148 (10.8%)	96 (12.5%)	75 (9.9%)	96 (12.5%)
Tx/NA	28 (2.0%)	16 (2.1%)	13 (1.7%)	16 (2.1%)
	$p = 0.828$		$p = 0.228$	
N-stage				
N0	825 (60.3%)	463 (60.5%)	474 (61.9%)	463 (60.5%)
N1	323 (23.6%)	180 (23.5%)	177 (23.1%)	180 (23.5%)
N2	199 (14.5%)	109 (14.3%)	103 (13.5%)	109 (14.3%)
N3	3 (0.2%)	0 (0%)	2 (0.3%)	0 (0%)
Nx/NA	19 (1.4%)	13 (1.7%)	9 (1.2%)	13 (1.7%)
	$p = 0.843$		$p = 0.638$	
M-stage				
M0	893 (65.2%)	504 (65.8%)	506 (66.1%)	504 (65.8%)
M1	155 (11.3%)	93 (12.2%)	77 (10.1%)	93 (12.2%)
Mx/NA	321 (23.4%)	168 (22.0%)	182 (23.8%)	168 (22.0%)
	$p = 0.668$		$p = 0.361$	
L-stage				
L0	607 (44.3%)	374 (48.9%)	334 (43.7%)	374 (48.9%)
L1	263 (19.2%)	138 (18.0%)	131 (17.1%)	138 (18.0%)
Lx/NA	499 (26.4%)	253 (33.1%)	300 (39.2%)	253 (33.1%)
	$p = 0.125$		$p = 0.720$	
V-stage				
V0	669 (48.9%)	404 (52.8%)	362 (48.3%)	404 (52.8%)
V1	186 (13.6%)	110 (14.4%)	97 (12.7%)	110 (14.4%)

V2	3 (0.2%)	0 (0%)	2 (0.3%)	0 (0%)
Vx/NA	511 (37.3%)	251 (32.8%)	304 (38.7%)	251 (32.8%)
	$p = 0.107$		$p = 0.447$	
Histological grade				
G1	27 (2.0%)	19 (2.5%)	15 (2.0%)	19 (2.5%)
G2	601 (43.9%)	380 (49.7%)	382 (49.9%)	380 (49.7%)
G3	155 (11.3%)	110 (14.4%)	90 (11.8%)	110 (14.4%)
Gx/NA	586 (42.8%)	256 (33.4%)	278 (36.3%)	256 (33.4%)
	$p \leq 0.001$		$p = 0.337$	

Abbreviations: IQR = Interquartile Range

Table 2: Parameters of surgery				
	Colon resection		**Rectal resection**	
	Statutory Insurance n= (%)	**Private Insurance** n= (%)	**Statutory Insurance** n= (%)	**Private Insurance** n= (%)
Parameters of surgical technique				
Surgical technique				
Open surgery/not otherwise indicated	317 (73.0%)	265 (60.1%)	196 (59.2%)	163 (50.3%)
Minimally invasive (laparoscopic or robotic) surgery	81 (18.7%)	149 (33.8%)	126 (38.1%)	142 (43.8%)
Conversion from minimally invasive to open surgery	36 (8.3%)	27 (6.1%)	9 (2.7%)	19 (5.9%)
	$p \leq 0.001$ OR for MIS approach: 1.79 (1.33-2.41), $p \leq 0.001$ OR for conversion: 2.44 (1.34-4.51) $p = 0.002$		$p = 0.023$ OR for MIS approach: 1.43 (1.04-1.97), $p = 0.023$ OR for conversion: 0.53 (0.20-1.29), $p = 0.163$	
Ileostomy formation				
Yes	15 (3.5%)	10 (2.3%)	85 (25.7%)	97 (29.9%)
No	419 (96.5%)	431 (97.7%)	246 (74.3%)	227 (70.1%)
	OR: 1.54 (0.63-3.88), $p = 0.31$		OR: 0.80 (0.56-1.15), $p = 0.256$	
Colostomy formation				
Yes	1 (0.2%)	1 (0.2%)	25 (7.6%)	24 (7.4%)
No	433 (99.8%)	430 (99.8%)	306 (92.4%)	300 (92.6%)
	OR: 1.01 (0.01-79.89), $p = 1$		OR: 1.02 (0.54-1.91), $p = 1$	
Parameters of oncological resection				
R-stage				
R0	407 (93.8%)	412 (93.4%)	313 (94.6%)	304 (93.8%)
R1	10 (2.3%)	11 (2.5%)	12 (3.6%)	12 (3.7%)
R2	6 (1.5%)	8 (1.8%)	1 (0.3%)	2 (0.6%)
Rx/NA	11 (2.5%)	10 (2.3%)	5 (1.5%)	6 (1.9%)
	$p = 0.928$ OR for R+ resection: 0.85 (0.40-1.77), $p = 0.730$		$p = 0.937$ OR for R+ resection: 0.90 (0.38-2.10), $p = 0.845$	
Lymph Nodes removed				
Mean				
Median [IQR]	21 (16-28)	19 (16-27)	18 (14-23.75)	18 (14-25)
NA	77	59	25	25
	$p = 0.447$		$p = 0.944$	
Lymph Nodes invaded				
Mean	2.29	3.15	1.95	1.55
Median [IQR]	0 (0-3)	1 (0-4)	0 (0-2)	0 (0-2)
NA	156	144	45	75
	$p = 0.03$		$p = 0.54$	
Abbreviations: IQR = Interquartile Range ; NA = Data not available				

Table 3: Complications				
	Colon resection		**Rectal resection**	
	Statutory Insurance n= (%)	**Private Insurance** n= (%)	**Statutory Insurance** n= (%)	**Private Insurance** n= (%)
Severity of intraoperative complication				
None	*417 (96.5%)*	*429 (98.2%)*	315 (96.6%)	298 (94.0%)
Simple	*8 (1.9%)*	*6 (1.4%)*	5 (1.5%)	7 (2.2%)
Intermediate	*5 (1.2%)*	*2 (0.5%)*	3 (0.9%)	3 (0.9%)
Severe	*2 (0.5%)*	0 (0%)	3 (0.9%)	9 (2.8%)
	p = 0.365		*p* = 0.308	
Overall postoperative complication rate				
No complication	*398 (91.7%)*	*406 (92.1%)*	241 (72.8%)	244 (75.3%)
Complication	*36 (8.3%)*	*35 (7.9%)*	90 (27.2%)	80 (24.7%)
	p = 0.901 OR: 1.04 (0.62-1.75)		*p* = 0.477 OR: 1.13 (0.79-1.62)	
Severity of postoperative complications according to Clavien-Dindo score				
Grade I	14 (38.9%)	10 (28.6%)	15 (16.7%)	21 (26.2%)
Grade II	11 (30.6%)	16 (45.7%)	47 (52.2%)	31 (38.8%)
Grade III	9 (25.1%)	8 (22.9%)	19 (21.1%)	20 (25%)
Grade IV	2 (5.6%)	1 (2.9%)	6 (6.7%)	6 (7.5%)
Grade V	0 (0%)	0 (0%)	3 (3.3%)	2 (2.5%)
	p = 0.140		*p* = 0.335	
Rates of specific postoperative complications				
Anastomotic failure	6 (1.4%)	5 (1.1%)	12 (3.6%)	11 (3.4%)
	p = 0.771 OR: 1.22 (0.30-5.10)		*p* = 0.499 OR: 1.07 (0.42-2.72)	
Seroma	3 (0.7%)	2 (0.5%)	1 (0.3%)	0 (0%)
	p = 0.684 OR: 1.52 (0.17-18.36)		*p* = 1 OR: Inf (0.02-Inf)	
Hematoma	2 (0.5%)	0 (0%)	1 (0.3%)	1 (0.3%)
	p = 0.245 OR: Inf (0.19-Inf)		*p* = 1 OR: 0.97 (0.01-77.02)	
Fascia Dehiscence	0 (0%)	0 (0%)	1 (0.3%)	0 (0%)
	p = 1 OR: 0 (0.00-Inf)		*p* = 1 OR: Inf (0.02-Inf)	
Superficial Wound Infection	1 (0.2%)	0 (0%)	0 (0%)	0 (0%)
	p = 0.496 OR: Inf (0.02-Inf)		*p* = 1 OR: 0 (0.00-Inf)	
Intraabdominal Abscess	2 (0.5%)	1 (0.2%)	3 (0.9%)	4 (1.2%)
	p = 0.621 OR: 2.03 (0.10-120.36)		*p* = 0.72 OR: 0.73 (0.10-4.36)	
Secondary Haemorrhage	2 (0.5%)	6 (1.4%)	2 (0.6%)	0 (0%)
	p = 0.286 OR: 0.33 (0.03-1.89)		*p* = 0.499 OR: Inf (0.18-Inf)	
Wound Healing Disorders	15 (3.5%)	3 (0.7%)	12 (3.6%)	13 (4.0%)
	***p* = 0.003** **OR: 5.21 (1.46-28.30)**		*p* = 0.840 OR: 0.90 (0.36-2.17)	
Urinary Tract Infection	8 (1.8%)	10 (2.3%)	10 (3.0%)	9 (2.8%)
	p = 0.812 OR: 0 (0.27-2.30)		*p* = 1 OR: 1.09 (0.39-3.07)	
Paralytic Ileus	12 (2.8%)	6 (1.4%)	10 (3%)	13 (4%)
	p = 0.159 OR: 1.05 (0.70-6.73)		*p* = 0.530 OR: 0.74 (0.28-1.87)	
Pneumonia	8 (1.8%)	1 (0.2%)	6 (1.8%)	3 (0.9%)
	***p* = 0.019** **OR: 8.24 (1.09-366)**		*p* = 0.505 OR: 1.97 (0.41-12.29)	

SUPPLEMENTARY INFORMATION TO MANUSCRIPT

INSURANCE STATUS DOES NOT AFFECT SHORT-TERM OUTCOMES AFTER ONCOLOGICAL COLORECTAL SURGERY IN EUROPE, BUT INFLUENCES THE USE OF MINIMALLY INVASIVE TECHNIQUES

A PROPENSITY SCORE MATCHED ANALYSIS

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Point 1: Information AQC database

The AQC (Swiss association for quality management in surgery;Arbeitsgemeinschaft für Qualitätssicherung in der Chirurgie, Switzerland) is maintaining a prospective database on patient and operative data in public Swiss hospitals. Today, more than 50 surgical departments are reporting their data to the AQC, making the AQC the largest national database for the assessment of surgical quality. Extracts of the database can be received freely on demand for research projects.

Homepage: http://www.aqc.ch/
Email: aqc@aqc.ch

The data imposed in the database can be reviewed under the following link (German, French & Italian):
http://www.aqc.ch/Willkommen-bei-der-AQC/Datenerfassung.aspx

Point 2: ICD-10-GM Codes for database filtering

The following ICD-10-GM Codes (Version 2016) were used for Identification of patients diagnosed with malignant colorectal carcinoma:

ICD-10 Code	Diagnosis
C18.0-9	Malignant neoplasm of colon
C19	Malignant neoplasm of recto-sigmoid junction
C20	Malignant neoplasm of rectum

Final database filtering and application of codes were done on the 30th of April 2017.

The current ICD-10-GM Codes (2016 version) were retrieved from the Swiss federal office of statistics, medical section, under the following links:

- https://www.bfs.admin.ch/bfs/de/home/statistiken/gesundheit/nomenklaturen/medkk/instrumente-medizinische-kodierung.html#par_headline_1153027117
- http://www.dimdi.de/static/de/klassi/icd-10-gm/kodesuche/onlinefassungen/htmlgm2016/index.htm

Point 3: Surgical CHOP codes for database filtering

All medical treatments, including surgical interventions, of in-hospital patients in Switzerland are coded according to guidelines of the Swiss federal office of Statistics (CHOP-Codes). These revised and up-to date CHOP Codes are issued annually and can be retrieved online:

- https://www.bfs.admin.ch/bfs/de/home/statistiken/gesundheit/nomenklaturen/medkk/instrumente-medizinische-kodierung.assetdetail.483959.html

For our study, the 2017 CHOP Codes were applied (issued on the 29th of June 2016) and final filtering according to the codes was done on the 30th of April 2017.

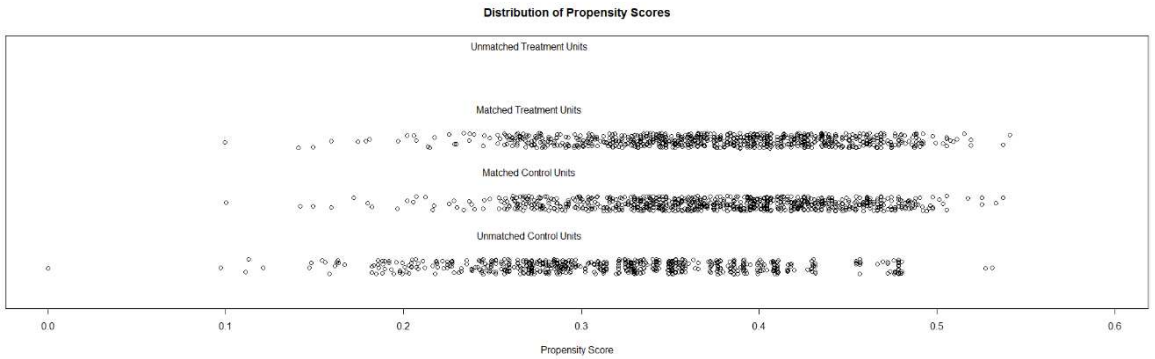
The following CHOP Codes (2017 version) were used for Identification of patients undergoing segmental/total colectomy or rectal resection:

CHOP Code	Treatment
45.7	Partial/segmental colectomy, including hemicolectomy left/right
45.8	Total colectomy
48.5	Abdominoperineal rectal resection
48.6	Other rectal resection

Point 4: Surgical CHOP codes for assessment of stoma formation

CHOP Code	Treatment
46.1	Colostomy
46.2/46.3	Ileostomy

Point 5/Figure: Distribution of propensity scores



Point 6: Hierarchical positions in swiss surgical departments and corresponding English expressions used in the manuscript

Hierarchical position in swiss surgical departments (German original denotation)	Corresponding English expression used in the manuscript
Assistenzarzt	Resident
Oberarzt	Junior attending surgeon
Leitender (Ober-)Arzt	Senior attending surgeon
Chefarzt	Chief of surgical department
Chirurg in Privatpraxis / Belegarzt	Surgeon in private practice

Point 7: Severity of intraoperative complications

Classification according to the guidelines of the Swiss society of anaesthesiology & resuscitation: http://www.sgar-ssar.ch/

Severity of intraoperative complications	
Simple	*Small temporary problem, easily controllable and/or self-limiting.*
Intermediate	*Intermediate problem, necessitates unplanned intervention and/or persisting despite initial treatment.*
Severe	*Severe, possible life-threatening problem, not responding on initial treatment and resulting in significant change in treatment-plan and/or necessitating follow up intervention/operation.*

Point 8/Table: Rates of specific intraoperative organ injures

Table: Intraoperative complications/organ injuries				
	Colon resection		**Rectal resection**	
	Statutory Insurance n= (%)	**Private Insurance** n= (%)	**Statutory Insurance** n= (%)	**Private Insurance** n= (%)
Intraoperative complications / organ injuries				
Biliary tract	0 (0%)	0 (0%)	0 (0%)	1 (0.3%)
	p = 1 OR: 0 (0.00-Inf)		*p* = 0.494 OR: 0.00 (0.00-38.17)	
Liver	0 (0%)	1 (0.2%)	0 (0%)	0 (0%)
	p = 1 OR: Inf (0.02- Inf)		*p* = 1 OR: 0 (0.00-Inf)	
Artery	2 (0.5%)	0 (0%)	1 (0.3%)	3 (0.9%)
	p = 0.245 OR: 0 (0.00-5.23)		*p* = 0.368 OR: 3.07 (0.24-162.25)	
Vein	2 (0.5%)	0 (0%)	*1 (0.3%)*	*1 (0.3%)*
	p = 0.245 OR: 0 (0.00-5.23)		*p* = 1 OR: 1.02 (0.01-80.39)	
Stomach/small intestine	*3 (0.7%)*	0 (0%)	2 (0.6%)	0 (0%)
	p = 0.121 OR: 0 (0.00-2.37)		*p* = 0.499 OR: 0.00 (0.00-5.43)	
Colon/rectum	*1 (0.2%)*	0 (0%)	1 (0.3%)	0 (0%)
	p = 0.496 OR: 0 (0.00-38.38)		*p* = 1 OR: 0.00 (0.00-39.84)	
Spleen	*1 (0.2%)*	*3 (0.7%)*	1 (0.3%)	2 (0.6%)
	p = 0.624 OR: 2.96 (0.23-155.92)		*p* = 0.620 OR: 2.04 (0.10-121.20)	
Ureter	2 (0.5%)	0 (0%)	0 (0%)	2 (0.6%)
	p = 0.245 OR: 0 (0.00-5.23)		*p* = 0.244 OR: Inf (0.19-Inf)	
Urinary bladder	0 (0%)	1 (0.2%)	1 (0.3%)	0 (0%)
	p = 1 OR: Inf (0.02- Inf)		*p* = 1 OR: 0.00 (0.00-39.84)	
Uterus/annexes	0 (0%)	0 (0%)	0 (0%)	1 (0.3%)
	p = 1 OR: 0 (0.00-Inf)		*p* = 0.494 OR: 0.00 (0.00-38.17)	
Kidney	0 (0%)	0 (0%)	1 (0.3%)	0 (0%)
	p = 1 OR: 0 (0.00-Inf)		*p* = 1 OR: 0.00 (0.00-39.84)	
Unspecified intraoperative complication	*1 (0.2%)*	*1 (0.2%)*	1 (0.3%)	2 (0.6%)
	p = 1 OR: 0.98 (0.01-77.38)		*p* = 0.620 OR: 2.04 (0.10-121.20)	

Point 9/Table: Rate of specific postoperative complications

Table: Specific postoperative complications				
	Colon resection		Rectal resection	
Parameter	**Statutory Insurance** n= (%)	**Private Insurance** n= (%)	**Statutory Insurance** n= (%)	**Private Insurance** n= (%)
Cardiovascular				
Myocardial Infarction	0 (0%)	2 (0.5%)	3 (0.9%)	0 (0%)
	p = 0.499 OR: 0 (0.00-5.40)		*p* = 0.248 OR: Inf (0.40-Inf)	
Arrhythmia	5 (1.2%)	3 (0.7%)	3 (0.9%)	1 (0.3%)
	p = 0.502 OR: 1.7 (0.32-11.02)		*p* = 0.623 OR: 2.95 (0.23-155.43)	
Low Output	0 (0%)	0 (0%)	0 (0%)	2 (0.6%)
	p = 1 OR: 0 (0.00-Inf)		*p* = 0.244 OR: 0.00 (0.00-5.20)	
Deep Vein Thrombosis	0 (0%)	0 (0%)	1 (0.3%)	0 (0%)
	p = 1 OR: 0 (0.00-Inf)		*p* = 1 OR: Inf (0.02-Inf)	
Pulmonary				
Pulmonary failure	2 (0.5%)	3 (0.7%)	2 (0.6%)	1 (0.3%)
	p = 1 OR: 0.67 (0.05-5.93)		*p* = 1 OR: 1.96 (0.10-116.11)	
Pulmonary Embolus	1 (0.2%)	0 (0%)	1 (0.3%)	0 (0%)
	p = 0.496 OR: Inf (0.02-Inf)		*p* = 1 OR: Inf (0.02-Inf)	
Pleural Effusion	0 (0%)	1 (0.2%)	2 (0.6%)	1 (0.3%)
	p = 1 OR: 0 (0.00-39.62)		*p* = 1 OR: 1.96 (0.10-116.11)	
Pneumothorax	0 (0%)	2 (0.5%)	0 (0%)	0 (0%)
	p = 0.499 OR: 0 (0.00-5.40)		*p* = 1 OR: 0 (0.00-Inf)	
Atelectasis	0 (0%)	1 (0.2%)	0 (0%)	0 (0%)
	p = 1 OR: 0 (0.00-39.62)		*p* = 1 OR: 0 (0.00-Inf)	
Gastrointestinal				
Gastrointestinal Bleeding	1 (0.2%)	2 (0.5%)	2 (0.6%)	0 (0%)
	p = 1 OR: 0.50 (0.00-9.77)		*p* = 0.499 OR: Inf (0.18-Inf)	
Small bowel obstruction	0 (0%)	3 (0.7%)	2 (0.6%)	8 (2.5%)
	p = 0.249 OR: 0 (0.00-2.45)		*p* = 0.060 OR: 0.24 (0.02-1.21)	
Liver Failure	0 (0%)	1 (0.2%)	0 (0%)	0 (0%)
	p = 1 OR: 0 (0.00-39.62)		*p* = 1 OR: 0 (0.00-Inf)	
Urogenital				
Renal failure	0 (0%)	3 (0.7%)	1 (0.3%)	4 (1.2%)
	p = 0.249 OR: 0 (0.00-2.45)		*p* = 0.212 OR: 0.24 (0.00-2.47)	
Electrolyte Disbalance	3 (0.7%)	0 (0%)	0 (0%)	2 (0.6%)
	p = 0.121 OR: Inf (0.42-Inf)		*p* = 0.244 OR: 0.00 (0.00-5.20)	
Bladder Tamponade	0 (0%)	1 (0.2%)	1 (0.3%)	1 (0.3%)
	p = 1 OR: 0 (0.00-39.62)		*p* = 1 OR: 0.97 (0.01-77.02)	
Urosepsis	3 (0.7%)	0 (0%)	0 (0%)	1 (0.3%)

	p = 0.121 OR: Inf (0.42-Inf)		p = 0.494 OR: 0.00 (0.00-38.17)	
Urinary Fistula	1 (0.2%)	0 (0%)	0 (0%)	1 (0.3%)
	p = 0.496 OR: Inf (0.02-Inf)		p = 0.494 OR: 0.00 (0.00-38.17)	
Urinary Retention	3 (0.7%)	3 (0.7%)	13 (3.9%)	5 (1.5%)
	p = 1 OR: 1.01 (0.13-7.63)		p = 0.092 OR: 2.60 (0.85-9.44)	
Infectious & Others				
Peritonitis	0 (0%)	0 (0%)	2 (0.6%)	1 (0.3%)
	p = 1 OR: 0 (0.00-Inf)		p = 1 OR: 1.96 (0.10-116.11)	
Sepsis	0 (0%)	3 (0.7%)	3 (0.9%)	2 (0.6%)
	p = 0.249 OR: 0 (0.00-2.45)		p = 1 OR: 1.47 (0.16-17.72)	
Multi Organ Failure	0 (0%)	2 (0.5%)	0 (0%)	0 (0%)
	p = 0.499 OR: 0 (0.00-5.40)		p = 1 OR: 0 (0.00-Inf)	
Coagulation Disorder	0 (0%)	0 (0%)	1 (0.3%)	0 (0%)
	p = 1 OR: 0 (0.00-Inf)		p = 1 OR: Inf (0.02-Inf)	
Anaesthesia related nerve pressure lesion	0 (0%)	1 (0.2%)	1 (0.3%)	3 (0.9%)
	p = 1 OR: 0 (0.00-39.62)		p = 0.368 OR: 0.32 (0.00-4.06)	
Psychosis	1 (0.2%)	1 (0.2%)	1 (0.3%)	0 (0%)
	p = 1 OR: 1.01 (0.01-79.89)		p = 1 OR: Inf (0.02-Inf)	
Delirium	0 (0%)	2 (0.5%)	1 (0.3%)	2 (0.5%)
	p = 0.499 OR: 0 (0.00-5.40)		p = 0.620 OR: 0.48 (0.00-9.42)	
Allergic reaction	0 (0%)	0 (0%)	1 (0.3%)	1 (0.3%)
	p = 1 OR: 0 (0.00-Inf)		p = 1 OR: 0.97 (0.01-77.02)	
Other, not specified	24 (5.5%)	14 (3.2%)	37 (11.2%)	37 (11.2%)
	p = 0.09 OR: 1.78 (0.87-3.78)		p = 1 OR: 0.97 (0.58-1.63)	
Surgery-related complications				
Douglas Abscess	0 (0%)	0 (0%)	0 (0%)	2 (0.6%)
	p = 1 OR: 0 (0.00-Inf)		p = 0.244 OR: 0.00 (0.00-5.20)	
Anastomotic Stricture	0 (0%)	1 (0.2%)	1 (0.3%)	1 (0.3%)
	p = 1 OR: 0 (0.00-39.62)		p = 1 OR: 0.97 (0.01-77.02)	
Ostomy-related Complications	0 (0%)	0 (0%)	3 (0.9%)	2 (0.6%)
	p = 1 OR: 0 (0.00-Inf)		p = 1 OR: 1.47 (0.16-17.72)	
Small bowel Fistula	0 (0%)	0 (0%)	1 (0.3%)	0 (0%)
	p = 1 OR: 0 (0.00-Inf)		p = 1 OR: Inf (0.02-Inf)	
Large bowel Fistula	0 (0%)	0 (0%)	0 (0%)	1 (0.3%)
	p = 1 OR: 0 (0.00-Inf)		p = 0.494 OR: 0.00 (0.00-38.17)	

Point 10: Session Info R-Studio

```
> sessionInfo()
R version 3.4.3 (2017-11-30)
Platform: x86_64-w64-mingw32/x64 (64-bit)
Running under: Windows >= 8 x64 (build 9200)

Matrix products: default

locale:
[1]           LC_COLLATE=German_Switzerland.1252                LC_CTYPE=German_Switzerland.1252
LC_MONETARY=German_Switzerland.1252 LC_NUMERIC=C
[5] LC_TIME=German_Switzerland.1252

attached base packages:
[1] stats     graphics  grDevices utils     datasets  methods   base

other attached packages:
 [1] bindrcpp_0.2.2      gridExtra_2.3       ggpubr_0.1.7        magrittr_1.5        ggsci_2.9           ggbeeswarm_0.6.0
RColorBrewer_1.1-2
 [8] ReporteRs_0.8.10    ReporteRsjars_0.0.4 rJava_0.9-10        forcats_0.3.0       dplyr_0.7.6         ggplot2_3.0.0

loaded via a namespace (and not attached):
 [1] beeswarm_0.2.3      tidyselect_0.2.4    purrr_0.2.5         colorspace_1.3-2    htmltools_0.3.6     yaml_2.1.19
base64enc_0.1-3   rlang_0.2.1
 [9] R.oo_1.22.0         pillar_1.3.0        later_0.7.3         glue_1.3.0          withr_2.1.2         R.utils_2.6.0       gdtools_0.1.7
uuid_0.1-2
[17] bindr_0.1.1         plyr_1.8.4          munsell_0.5.0       gtable_0.2.0        R.methodsS3_1.7.1 zip_1.0.0           labeling_0.3
knitr_1.20
[25] httpuv_1.4.5        vipor_0.4.5         Rcpp_0.12.17        xtable_1.8-2        scales_0.5.0        promises_1.0.1      mime_0.5
png_0.1-7
[33] digest_0.6.15       shiny_1.1.0         cowplot_0.9.3       grid_3.4.3          tools_3.4.3         lazyeval_0.2.1      tibble_1.4.2
crayon_1.3.4
[41] pkgconfig_2.0.1     xml2_1.2.0          rvg_0.1.9           assertthat_0.2.0    officer_0.3.1       rstudioapi_0.7      R6_2.2.2
compiler_3.4.3
```